AMENDMENTS TO THE SPECIFICATION

Please amend the paragraph beginning on page 1, line 26 as follows.

However, in consideration of reduction in ~~const~~ cost and in the area occupied by this circuit on an IC chip, the number of the operational amplifiers should be reduced.

Please amend the paragraph beginning on page 2, line 3 as follows.

Japanese patent No. 3-67211 (US patent Ser. No. 4,576,052) discloses another prior art physical quantity detection device satisfying this requirement. Fig. 6 is a schematic circuit diagram of this prior art physical quantity detection device including two operational amplifiers. This prior art physical quantity detection device provides the same function as the physical quantity detection device shown in Fig. 5 with only two operational amplifiers. In the case that the physical quantity detection device is used as a pressure sensor in motor vehicles, it is generally required that the physical quantity detection device is driven by a single power supply of 5 V, so that the output voltage range is from 0.5 to 4.5 V. Moreover, it is further required that the output voltage increases with an increase in ~~presser~~ pressure. Thus, in consideration of these general requirements, the prior art physical quantity detection device shown in Fig. 6 has the following disadvantages.

Please amend the paragraph beginning on page 5, line 17 as follows.

According to the present invention, a first aspect of the present invention provides a physical quantity detection device ~~comprising~~ including: an operational amplifier; a first resistor connected between an inverting input of ~~said~~ the operational amplifier and a first reference potential; a second resistor connected between ~~said~~ the inverting input of ~~said~~ the operational

amplifier and a second reference potential, ~~said~~ the first and second resistors having a first temperature coefficient of resistance; a feedback resistor being connected between ~~said~~ the inverting input of ~~said~~ the operational amplifier and an output of ~~said~~ the operational amplifier and having a second temperature coefficient of ~~resistor~~ resistance; and a reference voltage generation circuit generating a reference voltage supplied to a non-inverting input of ~~said~~ the operational amplifier, at least one of ~~said~~ the first and second resistors ~~comprising~~ including a sensing element of which resistance ~~varying~~ varies on the basis of a physical quantity with a temperature coefficient of sensitivity, wherein a difference between ~~said~~ the first temperature coefficient of resistance and ~~said~~ the temperature coefficient of sensitivity ~~being~~ is substantially equal to ~~said~~ the second temperature coefficient of resistance.

A2 Con't

Please amend the paragraph beginning on page 6, line 10 as follows.

A3

According to the present invention, a second aspect of the present invention provides the physical quantity detection device based on the first aspect, wherein each of ~~said~~ the first and second resistors and ~~said~~ the feedback resistor ~~comprises~~ includes a diffused resistor~~,~~ and a concentration of impurity of ~~said~~ the feedback resistor is different from concentrations of impurity of ~~said~~ the first and second resistors.

Please amend the paragraph beginning on page 6, line 16 as follows.

A4

According to the present invention, a third aspect of the present invention provides the physical quantity detection device based on the second aspect, wherein ~~said~~ the concentrations of impurity of ~~said~~ the first and second resistors are from 0.4×10^{19} cm^{-3} to 8×10^{19} cm^{-3} and ~~said~~ the concentration of impurity of ~~said~~ the feedback resistor is from 1.6×10^{17} cm^{-3} to 7 x

A4 Con't

10^{17} cm^{-3}. Moreover, ~~said~~ the concentrations of impurity of ~~said~~ the first and second resistors may be from 0.8 x 10^{19} cm^{-3} to 4 x 10^{19} cm^{-3} and ~~said~~ the concentration of impurity of ~~said~~ the feedback resistor is from 2.5 x 10^{17} cm^{-3} to 5.5 x 10^{17} cm^{-3}. Furthermore, ~~said~~ the concentrations of impurity of ~~said~~ the first and second resistors may be about 1 x 10^{19} cm^{-3}, and ~~said~~ the concentration of impurity of ~~said~~ the feedback resistor is about 4 x 10^{17} cm^{-3}.

Please amend the paragraph beginning on page 7, line 2 as follows.

A5

According to the present invention, a fourth aspect of the present invention provides the physical quantity detection device based on the first aspect, wherein one of ~~said~~ the first and second resistors ~~comprises~~ includes ~~said~~ the sensing element of which resistance varies on the basis of ~~said~~ the physical quantity, and a resistance of the other of ~~said~~ the first and second resistors does not vary with ~~said~~ the physical quantity.

Please amend the paragraph beginning on page 7, line 9 as follows.

A6

According to the present invention, a fifth aspect of the present invention provides the physical quantity detection device based on the first aspect, wherein ~~said~~ the reference voltage generation circuit includes third and fourth resistors connected in series between ~~said~~ the first and second reference potentials and generates a divided voltage as ~~said~~ the reference voltage, and a temperature coefficient of resistance of ~~said~~ the third resistor is substantially equal to a temperature coefficient of resistance of ~~said~~ the fourth resistor.

Please amend the paragraph beginning on page 7, line 17 as follows.

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ft7

According to the present invention, a sixth aspect of the present invention provides the physical quantity detection device based on the fifth aspect, wherein one of ~~said~~ the third and fourth resistors has a trimming structure to trim ~~said~~ the reference voltage toward an output voltage of ~~said~~ the operational amplifier ~~on~~ when ~~said~~ the physical quantity is zero.

Please amend the paragraph beginning on page 7, line 23 as follows.

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ft8

According to the present invention, a seventh aspect of the present invention provides the physical quantity detection device based on the first aspect, further ~~comprising~~ including a resistor having a trimming structure and that is connected in parallel to ~~said~~ the feedback resistor.

Please amend the paragraph beginning on page 8, line 1 as follows.

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ft9

According to the present invention, an eighth aspect of the present invention provides the physical quantity detection device based on the first aspect, further ~~comprising~~ including: a third resistor; another operational amplifier having an inverting input supplied with an output of ~~said~~ the operational amplifier through ~~said~~ the third resistor, a non-inverting input of ~~said~~ the another operational amplifier being supplied with ~~said~~ the reference voltage; and a fourth resistor disposed between an output terminal and inverting input of ~~said~~ the another operational ~~amplifer~~ amplifier.

Please amend the paragraph beginning on page 8, line 10 as follows.

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ft10

According to the present invention, a ninth aspect of the present invention provides the physical quantity detection device based on the eighth aspect, further ~~comprising~~ including an

A10 Cont

offset trimming resistor between ~~said~~ the first reference potential and ~~said~~ the inverting input of ~~said~~ the another operational amplifier.

Please amend the paragraph beginning on page 8, line 15 as follows.

A11

According to the present invention, a tenth aspect of the present invention provides the physical quantity detection device based on the ~~eight~~ eighth aspect, further ~~comprising~~ including an offset trimming resistor between ~~said~~ the second reference potential and ~~said~~ the inverting input of ~~said~~ the another operational amplifier.

Please amend the paragraph beginning on page 8, line 20 as follows.

A12

According to the present invention, an eleventh aspect of the present invention provides the physical quantity detection device based on the eighth aspect, further ~~comprising:~~ including fifth and sixth resistors connected between ~~said~~ the first reference potential and ~~said~~ the inverting input of ~~said~~ the second operational amplifier~~;~~ and seventh and eighth resistors connected between ~~said~~ the inverting input of ~~said~~ the another operational amplifier and ~~said~~ the second reference potential, wherein ~~said~~ the sixth and seventh resistors have temperature dependencies of resistance.

Please amend the paragraph beginning on page 9, line 3 as follows.

A13

According to the present invention, a twelfth aspect of the present invention provides the physical quantity detection device based on the eleventh aspect, wherein at least one of ~~said~~ the fifth and eighth resistors has a trimming structure for compensating a temperature characteristic of offset of the output of ~~said~~ the another operational amplifier.

Please amend the paragraph beginning on page 9, line 9 as follows.

According to the present invention, a thirteenth aspect of the present invention provides the physical quantity detection device ~~as claimed in claim 1,~~ wherein if it is assumed that a sensitivity of ~~said~~ the sensing element at a reference temperature is S0, a resistance of ~~said~~ the sensing element at ~~said~~ the reference temperature is R0, and a resistance of ~~said~~ the feedback resistor at ~~said~~ the reference temperature is Rts0, then, it is represented that ~~said~~ the sensitivity of ~~said~~ the sensing element at a temperature t which is different from ~~said~~ the reference temperature by T is S(T), ~~said~~ the resistance of ~~said~~ the sensing element at t is R(T), and ~~said~~ the resistance of ~~said~~ the feedback resistor at t is Rts(T), and S(T), R(T), and Rts(T) are further represented by: $S(T) = S0 \cdot (1 + \beta1 \cdot T + \beta2 \cdot T^2)$, $R(T) = R0 \cdot (1 + \alpha1 \cdot T + \alpha2 \cdot T^2)$, and $Rts(T) = Rts0 \cdot (1 + A1 \cdot T + A2 \cdot T^2)$, where ~~said~~ α1, α2, β1, β2, A1, and A2 are temperature coefficients, and wherein ~~said~~ α1, α2, β1, β2, A1, and A2 are determined so as to establish both $A1 = \alpha1 - \beta1$ and $A2 = \alpha2 - \beta2 - \beta1 \cdot (\alpha1 - \beta1)$.

ft14

Please amend the paragraph beginning on page 9, line 25 as follows.

ft15

According to the present invention, a fourteenth aspect of the present invention provides the physical quantity detection device based on the first aspect, wherein ~~said~~ the reference voltage is determined such that almost all of a current flowing through ~~said~~ the first resistor flows into ~~said~~ the second resistor.

Please amend the paragraph beginning on page 10, line 4 as follows.

According to the present invention, a fifteenth aspect of the present invention provides a physical quantity detection device ~~comprising~~ including: an operational amplifier; a first resistor connected between an inverting input of ~~said~~ the operational amplifier and a first reference potential; a second resistor connected between ~~said~~ the inverting input of ~~said~~ the operational amplifier and a second reference potential, ~~said~~ the first and second resistors having a first temperature coefficient of resistance; a feedback resistor being connected between ~~said~~ the inverting input of ~~said~~ the operational amplifier and an output of ~~said~~ the operational amplifier and having a second temperature coefficient of ~~resistor~~ resistance; a reference voltage generation circuit generating a reference voltage supplied to a non-inverting input of ~~said~~ the operational amplifier, at least one of ~~said~~ the first and second resistors ~~comprising~~ including a sensing element of which resistance ~~varying~~ varies on the basis of a physical quantity with a temperature coefficient of sensitivity, wherein ~~said~~ the reference voltage generation circuit includes a third resistor and a fourth ~~resistors~~ resistor connected in series between ~~said~~ the first and second reference potentials and generates a divided voltage as ~~said~~ the reference voltage, and a temperature coefficient of ~~said~~ the third resistor is substantially equal to a temperature coefficient of ~~said~~ the fourth resistor.

A16

Please amend the paragraph beginning on page 10, line 25 as follows.

A17

According to the present invention, a sixteenth aspect of the present invention provides a physical quantity detection device ~~comprising~~ including: an operational amplifier; a first resistor connected between an inverting input of ~~said~~ the operational amplifier and a first reference potential; a second resistor connected between ~~said~~ the inverting input of ~~said~~ the operational

amplifier and a second reference potential, ~~said~~ the first and second resistors having a first temperature coefficient of resistance; a feedback resistor being connected between ~~said~~ the inverting input of ~~said~~ the operational amplifier and an output of ~~said~~ the operational amplifier and having a second temperature coefficient of ~~resistor~~ resistance; a reference voltage generation circuit generating a reference voltage supplied to a non-inverting input of ~~said~~ the operational amplifier, at least one of ~~said~~ the first and second resistors ~~comprising~~ including a sensing element of which resistance ~~varying~~ varies on the basis of a physical quantity with a temperature coefficient of sensitivity, a third resistor; another operational amplifier, an inverting input of ~~said~~ the another operational amplifier being supplied with an output of ~~said~~ the operational amplifier through ~~said~~ the third resistor, a non-inverting input of ~~said~~ the another operational amplifier being supplied with ~~said~~ the reference voltage; and a fourth resistor disposed between an output terminal and the inverting input of ~~said~~ the another operational ~~amplifer~~ amplifier.

f17 cont

Please amend the paragraph beginning on page 14, line 19 as follows.

f18

Generally, if a ~~Wheastone bride~~ Wheatstone bridge is constructed with strain gages, the zero point deviates due to slight desperations among four diffused resistors such as dispersion in line width of diffused resistors, so that an offset voltage appears. Thus, conventionally offset adjustment was necessary before adjustment of pressure sensitivity and was carried out with either of ~~a circuit~~ the circuits shown in Fig. 2A or Fig. 2B.

Please amend the paragraph beginning on page 15, line 4 as follows.

f19

However, the resistors 50 to 53 should be subjected to laser trimming for the above-mentioned adjustment, so that thin film resistors having a temperature coefficient of ~~resistor~~

t19 Cont

resistance of almost zero such as CrSi are used as the resistors 50 to 53. Thus, difference in temperature coefficient of ~~resistor~~ resistance between the strain gages and these resistors occurs. Then, if its temperature varies, the zero point of the bridge will deviate from the previous point. That is, the temperature characteristic of the offset should be adjusted independently.

Please amend the paragraph beginning on page 16, line 1 as follows.

t20

Further, the resistors R1 and R2 are of the same type (have the same TCR). This structure prevents deviation of the zero point because resistors having different TCRs are not directly connected in the bridge structure. In addition, it is prevented that the reference voltage Vref varies with temperature variation. Accordingly, if the offset voltage of the operational amplifier OP1 is negligibly low, and the influence by the temperature characteristic of the offset voltage is also negligible, this structure further provides offset temperature characteristic compensation by the above-mentioned offset adjustment with either of the ~~resistor R2~~ resistors R1 or R2 at a temperature, such as a room temperature.

Please amend the paragraph beginning on page 17, line 17 as follows.

t21

In this circuit, the feedback resistor Rts comprises a temperature sensitive element, and its temperature coefficient of ~~resistor~~ resistance TCRts ~~of the feedback resistor Rts~~ is determined as follows:

Please amend the paragraph beginning on page 18, line 4 as follows.

The first term of Eq. (2) is Vref = Vcc/2, and the second term includes the pressure signal component. Thus, (V2 – Vref) can be regarded as the pressure signal. The second term of Eq.

(2) shows that a gage ratio $\Delta R/R$ decreases with increase in temperature. On the basis of this fact, the condition for temperature compensation for the output voltage V2 is determined by substituting the partial differentiation of the output voltage V2 with respective to temperature with zero. Then, Eq. (3) is established regarding the temperature coefficient of ~~resistor~~ resistance TCRts of the feedback resistor Rts as follows:

A21 Cont

$$TCRts \fallingdotseq TCR - TCS \qquad (3)$$

where TCR is a temperature coefficient of resistance of diffused resistors Ra and Rb, and TCS is a temperature coefficient of sensitivity of the diffused resistors Ra and Rb. Moreover, the temperature coefficient of ~~resistor~~ resistance TCRts of the feedback resistor Rts, the temperature coefficient of ~~resistor~~ resistance TCR of the diffused resistors Ra and Rb, and the temperature coefficient of sensitivity TCS are ~~represent~~ represented by:

Please amend the paragraph beginning on page 19, line 2 as follows.

A22

During obtaining of Eq. (3), $(\Delta R/R)^2$ is neglected because $\Delta R/R = 0.002$ to 0.02, i.e., $(\Delta R/R)^2 \ll 1$. From the above-mentioned relations, it is found that if the temperature coefficient of ~~resistor~~ resistance TCR of the feedback resistor Rts satisfies Eq. (3), the temperature characteristic of sensitivity can be compensated.

Please amend the paragraph beginning on page 27, line 15 as follows.

A23

These equations are simultaneous equations, wherein respective left sides are represented by coefficients of ~~resistor~~ resistance Rts and the right sides are represented by coefficients of ~~resistors~~ resistance Ra and Rb.

Please amend the paragraph beginning on page 31, line 5 as follows.

In the above-mentioned embodiments, both diffused resistors Ra and Rb comprise strain gages. However, another pressure sensor can be provided. This pressure sensor includes the diffused resistor Ra as the strain gage and the resistor Rb which may be formed as a resistor other than the strain gage having the same temperature coefficient of ~~resistor~~ resistance TCR as that of the diffused resistor Ra. More specifically, for example, only the diffused resistor Ra is formed in the diaphragm, and the diffused resistor Rb is formed at a place other than the diaphragm 10.

A24

Please amend the abstract of the disclosure beginning on page 41, line 5 as follows.

A25

First and second resistors (sensing elements) are connected in series between first and second potentials. The junction point voltage between the first and second resistor is supplied to an inverting input of a first operational amplifier. The non-inverting input is supplied with a reference voltage Vref generated by third and fourth resistors. A feedback resistor is connected between output and inverting input of the operational amplifier OP1. The difference between a temperature coefficient of ~~resistor~~ resistance TCR of the sensing elements and a temperature coefficient of sensitivity TCS is equalized to a temperature coefficient of ~~resistor~~ resistance of the feedback resistor. Further, the reference voltage is unchanged in accordance with the detected physical quantity or temperature variation.